CHAPTER 2. ANALYTIC FRAMEWORK

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CHAPTER 2. ANALYTIC FRAMEWORK

2.1 INTRODUCTION

Section 342(a)(6)(A) of Energy Policy and Conservation Act (EPCA) requires the DOE to set forth energy conservation standards that are technologically feasible and economically justified and would result in significant additional energy conservation. This chapter provides a description of the general analytical framework that the Department uses in developing such standards, with particular focus on residential furnaces and boilers. Essentially, the analytical framework is a description of the methodology, the analytical tools, and relationships among the various analyses that are part of this rulemaking. For example, the methodology that addresses the statutory requirement for economic justification includes analyses of life-cycle cost, economic impact on manufacturers and users, national benefits, impacts on utility, and any impacts from lessening competition. Several of these analyses will be conducted during the notice of proposed rulemaking (NOPR) stage of this rulemaking.

Figure 2.1.1 summarizes the analytical components of the standards-setting process. The focus of this figure is the center column, identified as "Analysis." The columns labeled "Key inputs" and "Key Outputs" indicate how the analyses fit into the rulemaking process, and how the analyses relate to each other. Key inputs are the types of data and information that the analyses require. Some key inputs exist in public databases; DOE collects other inputs from stakeholders or persons with special knowledge. Key outputs are analytical results that feed directly into the standards-setting process. Dotted lines connecting analyses indicate types of information that feed from one analysis to another.

The analyses performed in the advance notice of proposed rulemaking (ANOPR) stage (and reported in this Technical Support Document (TSD)) include:

- A market and technology assessment to characterize the relevant equipment markets and existing technology options.
- A screening analysis to review each technology option and determine if it is practicable to manufacture, install, and service, would adversely affect equipment utility or equipment availability, or would have adverse impacts on health and safety.
- Markups to describe how manufacturing costs are marked up to obtain retail prices.
- An engineering analysis to develop cost/efficiency relationships that show the cost of achieving increased efficiency.
- A life-cycle cost and payback period analysis to calculate, at the customer level, the discounted savings in operating costs (less maintenance and repair costs) throughout the estimated average life of the covered equipment, compared to any increase in the installed cost for the equipment likely to result directly from the imposition of the standard.
- Shipments to describe the methodology for forecasting shipments by product class, in the absence or presence of new regulations.

- A national impacts analysis to assess the aggregate impacts at the national level of the net present value (NPV) of total consumer life-cycle cost and national energy savings.

The analyses to be performed in the subsequent NOPR stage include those listed below. In addition, DOE re-analyzes the work done in the ANOPR stage.

- A life-cycle cost sub-group analysis to evaluate variations in key factors (e.g., energy prices, equipment use behavior, installation costs) that might cause a standard to impact particular customer sub-populations differently than the overall population.
- A manufacturer impact analysis to estimate the financial impact of standards on manufacturers and to calculate impacts on competition, employment, and manufacturing capacity.
- A utility impact analysis to estimate the effects of proposed standards on electric and gas utilities.
- A net national employment impact analysis to assess the aggregate impacts on national employment.
- An environmental assessment to provide estimates of changes in emissions of pollutants (nitrogen oxides, sulfur, and carbon dioxide).
- A regulatory impact analysis to present major alternatives to proposed standards that could achieve substantially the same regulatory goal at a lower cost.

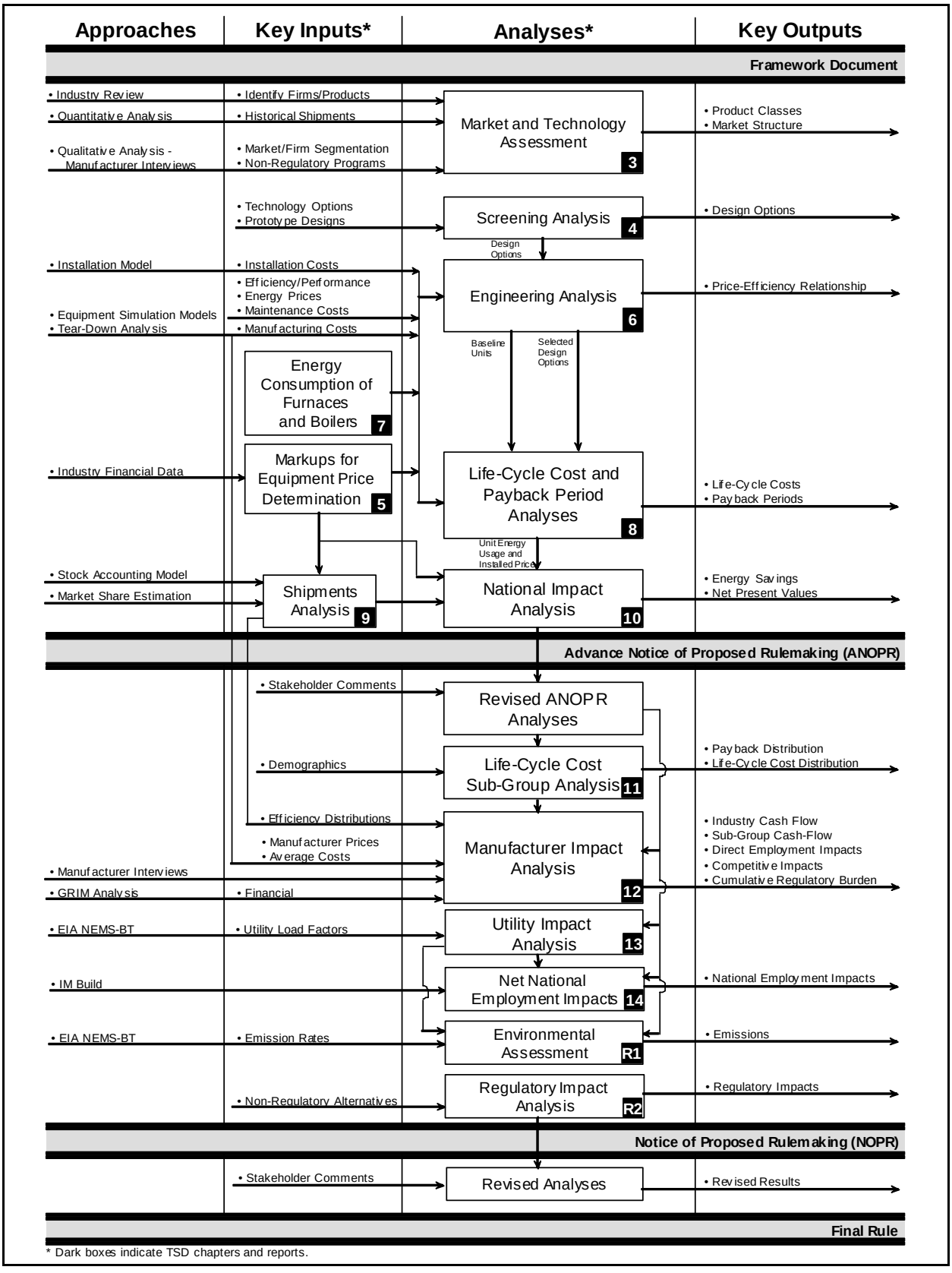

Figure 2.1.1 Analytic Framework for Residential and Boilers Rulemaking

2.2 BACKGROUND

As described in Chapter 1, the Process Rule outlined procedural improvements to the standards rulemaking process which included a review of the following elements used in the rulemaking process: (1) economic models; (2) analytical tools; (3) methodologies; (4) non-regulatory approaches; and (5) prioritization of future rules. See appendix A to subpart C of Title 10 Code of Federal Regulations Part 430 (10 CFR Part 430). Also, the Process Rule required the Department to take into account uncertainty and variability by doing scenario or probability analyses.

The Department developed the analytical framework for the furnace and boiler rulemaking pursuant to the Process Rule. The Department presented this analytical framework to stakeholders during the Framework workshop held on July 17, 2001. The following sections provide a general description of the different analytical components of the rulemaking framework.

2.3 MARKET AND TECHNOLOGY ASSESSMENT

The market and technology assessment characterizes the relevant product markets and existing technology options, including prototype designs.

2.3.1 Market Assessment

When initiating a standards rulemaking, the Department develops information on the present and past industry structure and market characteristics for the equipment concerned. This activity assesses the industry and equipment both quantitatively and qualitatively, based on publicly available information.

The Department reviewed existing marketing materials and literature, and interviewed manufacturers to get an overall picture of the market for furnaces and boilers in the United States. Industry publications and trade journals, government agencies, and trade organizations provided most of the information, including: (1) manufacturer market share, (2) equipment efficiency, and (3) shipments by capacity and efficiency level.

The Department has used and will use the most reliable and accurate data available at the time of each analysis in this rulemaking. All data will be available for public review. The Department welcomes and will consider any recommendations of additional data.

2.3.2 Technology Assessment

The Department typically uses information relating to existing and past technology options and prototype designs as inputs to determine what technologies manufacturers utilize to attain higher energy efficiency levels. In consultation with interested parties, the Department

develops a list of technologies that can and should be considered. Initially, these technologies encompass all those considered to be technologically feasible.

The Department developed its list of technologically feasible design options in consultation with manufacturers of components and systems, and with trade publications and technical papers. Since many options for improving product efficiency are available in existing equipment, product literature and direct examination provided additional information.

2.3.3 Product Classes

The EPCA Section 321 (23) states that the term "furnace" includes forced-air and gravity central furnaces and low-pressure steam and hot-water boilers with a heat input of less than 300,000 Btu/hr for boilers and less than 225,000 Btu/hr for furnaces. For this rulemaking, however, DOE adopted the terminology used in the heating, ventilation, and air-conditioning (HVAC) industry, which considers furnaces and boilers as separate categories, within the above size ranges.

Based on the market and technology assessment and stakeholder comments, DOE developed a number of well-defined product classes. For the current analyses, DOE modified the product classes it had defined in the ANOPR for residential furnaces and boilers issued on September 8, 1993. 58 FR 47326. The product classes considered are:

- Gas furnaces
  - Non-weatherized
  - Weatherized
- Oil-fired furnaces
  - Non-weatherized
  - Weatherized
- Mobile home furnaces
  - Gas
  - Oil
- Electric resistance furnaces
- Hot water boilers
  - Gas
  - Oil
- Steam boilers
  - Gas
  - Oil
- Combination space/water heating appliances
  - Water-heater/fancoil combination units
  - Boiler/tankless coil combination units

2.4 SCREENING ANALYSIS

The screening analysis examines various technologies as to whether they: (a) are technologically feasible; (b) are impracticable to manufacture, install, and service; (c) have an adverse impact on equipment utility or availability; and (d) have adverse impacts on health and safety. As previously described in the section describing the technology assessment, DOE developed an initial list of efficiency enhancement options from the technologies identified in the technology assessment. Then the Department, in consultation with interested parties, reviewed the list to determine if these options are practicable to manufacture, install, and service, would adversely affect equipment utility or availability, or would have adverse impacts on health and safety. The Department further scrutinized efficiency enhancement options not eliminated in the screening process in the engineering analysis.

Chapter 4 provides an overview of the screening of design options for residential furnace and boilers.

2.5 ENGINEERING ANALYSIS

As presented in Chapter 6, the engineering analysis establishes the relationship between the cost and efficiency of furnaces and boilers. To estimate the cost to consumers of furnaces and boilers, the Department estimated manufacturing costs, markups in the distribution chain, installation costs, and maintenance costs. DOE then calculated payback periods for higher-efficiency equipment, calculating furnace or boiler energy use according to the DOE test procedure, 10 CFR Part 430, subpart B, Appendix N, Uniform Test Method for Measuring the Energy Consumption of Furnaces and Boilers.

2.5.1 Baseline Model

In order to analyze design options for energy efficiency improvements, the Department defined a baseline model unit for each product class. The Department defined baseline models as appliances with the most popular and cost-effective features that just meet the current minimum efficiency standard. In its selection process, DOE considered technical descriptions of the covered equipment, definitions of the product classes as described in the framework document, results of the Market Assessment, and suggestions from stakeholders.

2.5.2 Manufacturing Cost Analysis

There are several ways to develop the relationship between cost and performance. The Department chose to use a component-based engineering analysis, or teardown analysis. This approach provides information for the analysis by identifying potential technological paths manufacturers could use to achieve increased equipment energy efficiency. The Department purchased “off-the-shelf” units commercially available on the market and physically analyzed them, i.e., dismantled them component-by-component to determine what technologies and designs manufacturers currently employ to increase energy efficiency. The Department then

used independent costing methods, along with manufacturer and component-supplier data, to estimate the costs of the components.

The Department determined the efficiency levels corresponding to various design options from commercially available information on products, data submitted by manufacturers, and/or engineering calculations. The Department obtained cost estimates from detailed incremental manufacturer cost data, which include the cost of the equipment components, labor, purchased parts and materials, shipping/packaging, and investment. The Department estimated manufacturing costs using a combination of teardown analysis, manufacturer-supplied estimates, and direct estimates of retail prices. The Department used a single set of cost-efficiency estimates in its analysis, and accounted for variability and uncertainty by using ranges, rather than by analyzing competing scenarios.

The teardown analysis used data provided directly by individual manufacturers through a process approved by the Gas Appliance Manufacturers Association (GAMA). Since the Department analyzed only the "off-the-shelf" equipment at hand, the analysis could not capture new combinations of existing technologies or prototypical designs.

2.5.3 Markup Analysis

To carry out the engineering and life-cycle cost analyses (LCC), DOE needed to determine the cost to the customer of a baseline model furnace or boiler and the cost of more-efficient units. However, the customer price of such units is not generally known. By applying a multiplier called a "markup" to the manufacturers' costs estimated in the engineering analysis, DOE estimated the customers' prices for baseline model and more-efficient equipment. In addition to estimating average markups, the Department characterized the markups with probability distributions through a statistical analysis of U.S. Census data. The Department used these distributions in the LCC Analysis.

The Department defined two types of distribution channels that describe how most equipment passes from the manufacturer to the customer. The first distribution channel applies to furnaces and boilers installed in retrofit applications. In this distribution channel, the manufacturer sells the equipment to a wholesaler, who in turn sells it to a contractor, who in turns sells it to the customer. The second distribution channel applies to furnaces and boilers installed in new construction, and thus includes an additional link in the chain—the home builder. In this distribution channel, the manufacturer sells the equipment to a wholesaler, who in turn sells it to a contractor, who in turn sells it to a builder, who in turns sells it to the customer.

For each of the markups, DOE further differentiated between a baseline markup and an incremental markup. The Department defines baseline markups as coefficients that relate the manufacturer price of baseline model to the wholesale or contractor sales price of such equipment. Incremental markups are coefficients that relate changes in the manufacturer price of baseline model to changes in the wholesale or contractor sales price.

2.5.4 Installation Cost Analysis

To determine installation costs, DOE developed a cost model, called the "Installation Model," for four high-sales-volume product classes: non-weatherized gas furnaces, hot water gas boilers, oil-fired furnaces, and oil-fired boilers. The Department used RS Means, a well-known and respected construction cost estimation method, to develop labor costs, and obtained quotes from national distributors to develop material costs. In the Installation Model, detailed costs were weight-averaged for a large variety of typical installations in the field, including both new construction and retrofit installations; single and multifamily housing; plastic, metal and masonry chimney vents; single and double-wall vent connectors; and common venting with other appliances. Chimney relining practices and orphaned water heaters were explicitly modeled.

Weatherized gas furnaces and mobile home furnaces have no vent or a very short vent; therefore a venting cost model is not required. Simpler RS Means estimates, and estimates of factory installation costs, were applied to estimate installation costs for these product classes.

2.6 LIFE-CYCLE COST AND PAYBACK PERIOD ANALYSIS

In determining whether an energy efficiency standard is economically justified, EPCA directs DOE to consider the economic impact of potential standards on consumers. To address that impact, the Department calculated changes in equipment LCC for consumers that are likely to result from a candidate standard, as well as payback periods (PBPs). The effects of standards on individual consumers include changes in operating expenses (usually lower) and changes in total installed cost (usually higher). The Department analyzed the net effect of these changes by calculating the changes in LCC compared to a base case forecast. The LCC calculation considers total installed cost (equipment purchase price plus installation cost), operating expenses (energy and maintenance costs), equipment lifetime, and discount rate. The analysis compares the LCC of equipment with various design options—models with efficiency improvements designed to meet possible energy-efficiency standards—with the LCC of the equipment chosen in the absence of standards.

The PBP represents the number of years of operation required to achieve savings sufficient enough to pay for the increased efficiency features. It is the change in total installed cost due to an increased efficiency standard divided by the change in annual operating cost from increased efficiency.

The Department conducted the analysis using a range of typical values to reflect conditions in the field for appliance price and life, fuel costs, energy usage, and discount rates. Much of the input for this analysis came from the Engineering Analysis. Other major inputs are a database of furnace and boiler specifications, and distributions of manufacturing costs from GAMA.

In previous analyses, the Department estimated the life-cycle costs of consumer energy savings possible from appliance energy-efficiency standards, based on average energy prices.

Using marginal energy prices (the cost of the last unit of energy purchased or saved) in these analyses is more theoretically sound. In April 1998, the Advisory Committee on Appliance Energy Efficiency Standards recommended that DOE replace the use of national average energy prices with the full range of consumer marginal energy rates in its LCC analyses. In this analysis, the Department used data from DOE's Energy Information Administration (EIA)'s Residential Energy Consumption Survey (RECS) to calculate marginal energy prices for residential consumers.[2]

Using data from RECS, the Department developed a representative sample of households for each of the analyzed product classes. To account for the variability and uncertainty among consumers, the Department used a weighted sampling of households with furnaces and boilers from the RECS database. The LCC model uses Monte Carlo simulations to perform the analysis. The model specifies uncertainty and variability in the inputs with probability distributions.

Based on results of the LCC and PBP Analysis, DOE selected candidate standard levels for analysis. The national impacts analysis used the outputs of the LCC Analysis.

2.7 NATIONAL IMPACTS ANALYSIS

The assessment of the aggregate impacts of new standards at the national level reports national energy savings (NES) and the net present value (NPV) of standards for consumers. Analyzing impacts of standards requires a comparison of projected energy consumption with and without new standards. The Department refers to the cases without new standards as base case forecast projections. The forecasts contain projections of annual equipment shipments, unit energy consumption of new equipment, and the total price of purchased equipment.

2.7.1 Shipments Analysis

The shipments forecast produces the market shares by product class for furnace and boilers shipments, and the total number of furnaces and boilers of all fuel types purchased in a year. The Department first developed a base case forecast of equipment shipments in the absence of new standards. This forecast included a distribution of shipments by efficiency level. The Department used an accounting model to track units installed in new construction and existing buildings. The Department based the retirement of units on the range of lifetimes of the equipment. The Department expressed product saturation rates as a function of consumer price and operating cost to capture the impact of candidate standard levels on shipments.

2.7.2 National Energy Savings Analysis

The Department calculated the national energy consumption by multiplying the number of units, or stock, of furnaces and boilers (by vintage) by the unit energy consumption (also by vintage). Vintage represents the age of the equipment. The Department calculated national annual energy savings from the difference between national energy consumption in the base case forecast (without new standards) and in each standards case forecast. The analysis included estimated energy savings by fuel type used for generating electricity. The Department estimated

energy consumption and savings based on site energy, and then converted the site energy consumption and savings to source energy. Cumulative energy savings are the sum of the annual NES which DOE determined over specified time periods.

The stock of equipment is dependent on annual shipments and the lifetime of the equipment. The Department conducted shipments projections under the base case forecast and standards case forecasts for a variety of possible equipment efficiency scenarios and equipment efficiency trends. It determined that shipment projections under the standards cases were lower than those from the base case forecast projection, because of the higher installed cost of the more-efficient equipment. As a result, the Department used the standards case shipments projection and, in turn, the resulting stock of equipment under the standards case, to determine the NES. Calculating the NES in this manner avoids the inclusion of savings resulting from displaced shipments.

Therefore, the inputs for the determination of NES are: (1) annual energy consumption per unit; (2) shipments; (3) equipment stock; (4) national energy consumption; and (5) site-to-source conversion factors.

2.7.3 Net Present Value Analysis

The Department calculated net savings each year as the difference between total operating cost savings (including electricity, repair, and maintenance cost savings) and increases in total installed costs (including equipment price and installation cost). It calculated savings over the life of the equipment, accounting for differences in yearly energy rates. The Department calculated NPV as the difference between the present value of operating cost savings and the present value of increased total installed costs. It discounted future costs and savings to the present with a discount factor.

The Department calculated increases in total installed costs as the product of the difference in the total installed cost between the base case forecast and standards case forecast and the annual sales volume or shipments in the standards case. Because costs of the more-efficient equipment purchased in the standards case are higher than those of equipment purchased in the base case forecast, price increases appear as negative values in the NPV.

The Department expressed operating cost savings as decreases in operating costs associated with the higher energy efficiency of equipment purchased in the standards case compared to the base case forecast. Total operating cost savings are the product of savings per unit and the number of units of each vintage surviving in a particular year.

The inputs for the determination of NPV are: (1) total annual installed cost; (2) total annual operating cost savings; (3) discount factor; (4) present value of costs; and (5) present value of savings.

2.8 LIFE-CYCLE COST SUBGROUP ANALYSIS

The LCC sub-group analysis evaluates economic impacts on sub-groups of customers, particularly those who might be adversely affected by any change in the national energy efficiency standards levels for furnaces and boilers. The Department will conduct the LCC Sub-Group during the NOPR stage of this rulemaking. The Department intends to evaluate the impacts of particular sub-groups of customers in part by analyzing the LCC and PBP for these particular customers.

The Department intends to evaluate variations both in regional energy prices and use that might affect the NPV of an energy efficiency standard to customer sub-groups. To the extent possible, the Department will obtain estimates of the variability of each input parameter and consider this variability in its calculation of customer impacts. Variations in energy use for a particular equipment type depend on factors such as climate and building type. The Department intends to perform sensitivity analyses to consider how differences in energy use will affect various sub-groups of customers.

The Department will determine the impact on customer sub-groups using the LCC spreadsheet model. The spreadsheet model used for the LCC Analysis can be used with different data inputs. The Department can analyze the LCC for any sub-group by using the LCC spreadsheet model and only sampling that sub-group. Details of this model are explained in the section describing the LCC and PBP Analyses.

The Department will be particularly sensitive to increases in the purchase price of furnaces and boilers in order to avoid a negative economic impact on any identified customer sub-group.

2.9 MANUFACTURER IMPACT ANALYSIS

The Department will conduct the manufacturers impact analysis (MIA) after the ANOPR and report the results in the NOPR. This analysis will estimate the financial impact of standards on manufacturers and also calculate the impact of standards on competition, direct employment, and manufacturing capacity within the industry. Three important elements of the approach consist of the preparation of an industry cash flow, the development of a process to consider sub-group cash flow, and the design of a guide to interview manufacturers and others in gathering information.

The policies outlined in the *Process Rule* resulted in substantial revisions to the analytical framework to be used in performing the MIA for each rulemaking. In the approach document, the Department will describe and obtain comments on the methodology to be used in performing the MIA. The MIA will be conducted in three phases. Phase 1 consists of two activities, namely, preparation of an industry characterization and identification of issues. Phase 2 evaluates the industry from a macro perspective. In this phase, the Government Regulatory Impact Model (GRIM) will be used to perform an industry cash flow analysis. Phase 3 involves repeating the process described in Phase 2 (the industry cash-flow analysis) but on different sub-

groups of manufacturers. Phase 3 also entails calculating additional impacts on competition, direct employment, and manufacturing capacity.

2.9.1 Industry Characterization

Phase 1 of the MIA consists of collecting pertinent financial and market information. This activity involves both quantitative and qualitative efforts. Data gathered includes market share, corporate operating ratios, wages, employment, and production cost ratios. These data are incorporated into the engineering analysis in the estimation of equipment production costs and distribution markups. Sources of information typically used for Phase 1 include experts from industry as well as reports published by industry groups, trade journals, the U.S. Census Bureau, and u.s. Securities and Exchange Commission (SEC) 10-K filings.

2.9.2 Industry Cash Flow

Increased efficiency standards affect manufacturers in three ways: 1) by requiring additional investment, 2) by raising production costs, and 3) by affecting revenue because of higher prices, and possibly, lower quantities sold. To quantify these manufacturer impacts, the Department performs an industry cash flow analysis using the GRIM. Usually this analysis will use manufacturing costs, shipments forecasts, and price forecasts developed for the LCC and NES analyses. Financial information, also required as an input to GRIM, will be developed based on publicly available data and manufacturer information confidentially submitted to the Department's contractor.

The GRIM analysis uses a number of factors—annual expected revenues; manufacturer costs such as cost of sales, selling, general and administrative (SG&A) costs, property taxes, and capital expenditures related to depreciation, new standards, and maintenance—to arrive at a series of annual cash flows beginning from before implementation of standards and continuing explicitly for several years after implementation. Industry net present values are calculated by discounting the annual cash flows from the period before implementation of standards to some future point in time.

2.9.3 Manufacturer Sub-Group Analysis

Assessment of impacts on sub-groups of manufacturers is Phase 3 of the MIA. Using industry "average" cost values is not adequate for assessing the variation in impacts among sub-groups of manufacturers. Smaller manufacturers, niche manufacturers or manufacturers exhibiting a cost structure largely different from industry averages could be affected differently. Ideally, the Department would consider the impact on every firm individually. In highly concentrated industries this may be possible. In industries having numerous participants, the Department uses the results of the industry characterization to group manufacturers exhibiting similar characteristics. The financial analysis of the "prototypical" firm performed in the Phase 2 industry analysis can serve as a benchmark against which manufacturer sub-groups can be analyzed.

The manufacturing cost data collected for the engineering analysis will be used to the extent practical in the sub-group impact analysis. To be useful, however, these data should be dis-aggregated to reflect the variability in costs between relevant sub-groups of firms.

The Department will conduct detailed interviews with manufacturers to gain insight into the potential impacts of standards. During these interviews, the Department will solicit the information necessary to evaluate cash flows and to assess impacts on competition, direct employment and manufacturing capacity. Company-specific cumulative burden will also be considered.

2.9.4 Interview Process

The revised rule-making process provides for greater public input and for improved analytical approaches, with particular emphasis on earlier and more extensive information gathering from interested parties. The proposed three-phase MIA process will draw on multiple information sources, including structured interviews with manufacturers and a broad cross-section of interested parties. Interviews may be conducted in any and all phases of the analyses as determined in Phase 1 of the MIA.

The interview process has a key role in the MIA, since it provides an opportunity for manufacturers to privately express their views on important issues. A key characteristic of the interview process is that it is designed to allow confidential information to be considered in the rule-making process.

The initial industry characterization will collect information from relevant industry and market publications, industry trade organizations, company financial reports, and product literature. This information will aid in the development of detailed and focused questionnaires, as needed, to perform all phases of the MIAs. It is the intention of the Department that the contents of questionnaires and the list of interview participants be publicly vetted prior to initiating the interview process.

The Phase 3 (sub-group analysis) questionnaire will solicit information on the possible impacts of potential efficiency levels on manufacturing costs, product prices, and sales. Evaluation of the possible impacts on direct employment, capital assets, and industry competitiveness will also draw heavily on the information gathered during the interviews. The questionnaires will solicit both qualitative and quantitative information. Supporting information will be requested whenever applicable.

Interviews will be scheduled well in advance to provide every opportunity for key individuals to be available for comment. Although a written response to the questionnaire is acceptable, an interactive interview process is preferred because it helps clarify responses and provides the opportunity for additional issues to be identified.

Interview participants will be requested to identify all confidential information provided in writing or orally. Approximately two weeks following the interview, an interview summary will be provided to give participants the opportunity to confirm the accuracy and protect the

confidentiality of all collected information. All the information transmitted will be considered, when appropriate, in the Department's decision-making process. However, confidential information will not be made available in the public record.

The Department's contractor will collate the completed interview questionnaires and prepare a summary of the major issues and outcomes. The Department will seek public comment on the outcome of the interview process.

2.9.5 Competitive Impact Assessment

Executive Order 12866 directs the Department to consider any lessening of competition that is likely to result from standards. It further directs the Attorney General to gauge the impacts, if any, of any lessening of competition. The Department will make an effort to gather and report firm-specific financial information and impacts. The competitive analysis will focus on assessing the impacts to smaller, yet significant, manufacturers. The Department will base the assessment on manufacturing cost data and on information collected from interviews with manufacturers, consistent with Phase 3 of the MIA. The Department of Justice (DOJ) has offered to help in drafting questions to be used in the manufacturer interviews. These questions will pertain to the assessment of the likelihood of increases in market concentration levels and other market conditions that could lead to anti-competitive pricing behavior. The manufacturer interviews will focus on gathering information that would help in assessing asymmetrical cost increases to some manufacturers, increased proportion of fixed costs potentially increasing business risks, and potential barriers to market entry (e.g., proprietary technologies).

2.10 UTILITY IMPACTS ANALYSIS

In order to estimate the effects of any proposed energy-efficiency standards for furnaces and boilers on the electric utility industry, the Department intends to use a variant of DOE/EIA's National Energy Modeling System (NEMS).[a] The NEMS is used by DOE/EIA to produce the *2003 Annual Energy Outlook* (*AEO2003*). The Department will use a variant, known as NEMS-BT, to provide key inputs to the analysis and generate the impacts on the electric utility industry from proposed energy-efficiency standards levels. Thus, the utility impact analysis is a comparison between NEMS-BT results for the base case forecast and for policy cases in which proposed standards are in place. The intended results of the analysis would consist of forecasted differences between the base case forecast and standards case forecasts for electricity generation, installed capacity, sales, and prices. The Department will conduct the utility impact analysis during the NOPR stage of this rulemaking.

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[a] For more information on NEMS, refer to the U.S. Department of Energy, Energy Information Administration documentation. A useful summary is the *National Energy Modeling System: An Overview 2000*, DOE/EIA-0581(2000), March, 2000. DOE/EIA approves use of the name NEMS to describe only an official version of the model without any modification to code or data. Because this analysis entails some minor code modifications and the model is run under various policy scenarios that are variations on DOE/EIA assumptions, DOE refers to it by the name NEMS-BT (BT is DOE's Building Technologies Program, under whose aegis this work has been performed). NEMS-BT was previously called NEMS-BRS.

In general, the use of NEMS-BT for the utility impact analysis offers several advantages. As the official DOE energy forecasting model, it relies on a set of assumptions that are transparent and have received wide exposure and commentary. The NEMS-BT allows an estimate of the interactions between the various energy supply and demand sectors and the economy as a whole. The utility impact analysis would report any changes in installed capacity and generation of electricity by fuel type which resulted from each trial energy efficiency standard level, as well as changes in electricity sales.

The Department conducts the utility impact analysis as a policy deviation the *AEO2003*, applying the same basic set of assumptions. For example, the operating characteristics (e.g., energy conversion efficiency and emissions rates) of future electricity generating plants are as specified in the *AEO2003* reference case, as are the prospects for natural gas supply.

The Department will explore deviations from some of the reference case assumptions corresponding to medium growth in order to represent alternative futures. Two such alternative scenarios use the high and low economic growth cases of *AEO2003*. The high economic growth case assumes higher projected growth rates for population, labor force, and labor productivity, resulting in lower predicted inflation and interest rates, and higher overall aggregate economic growth, relative to the reference case. The opposite is true for the low-growth case. While supply-side growth determinants are varied in these cases, *AEO2003* assumes the same reference case energy prices for all three economic growth cases. Different economic growth scenarios will affect the rate of growth of electricity demand.

2.11 NET NATIONAL EMPLOYMENT IMPACT ANALYSIS

The Department intends to estimate the impacts of energy-fficiency standards for furnaces and boilers on employment for equipment manufacturers, relevant service industries, energy suppliers, and the economy in general. The Department will conduct Employment Impact analysis during the NOPR stage of this rulemaking. The Department will separate employment impacts into indirect and direct impacts. Direct employment impacts would result if standards led to a change in the number of employees at manufacturing plants and related supply and service firms.

Indirect impacts are impacts on the national economy other than in the manufacturing sector being regulated. Indirect impacts might result both from expenditures shifting among goods (substitution effect), and changes in income, which could lead to a change in overall expenditure levels (income effect). The Department defines indirect employment impacts from energy-efficiency standards as net jobs eliminated or created in the general economy, as a consequence of increased spending on the purchase price of equipment and reduced customer spending on energy.

The Department believes that new furnace and boiler standards will increase the total installed cost of equipment. It expects the same standards to decrease energy consumption, and therefore to reduce customer expenditures for energy. Over time, the increased total installed

cost would be paid back through energy savings. The savings in energy expenditures could then be spent on new investment and other items. Using an input/output model of the U.S. economy, this analysis seeks to estimate the effects on different sectors and the net impact on jobs. The Department intends to estimate national impacts for major sectors of the U.S. economy in the NOPR. It intends to use public and commercially available data sources and software to estimate employment impacts.

The Department's Building Technologies Program (BT) developed a spreadsheet model (IMBUILD) that can be used to analyze indirect employment impacts. IMBUILD is a special purpose version of the Impact Analysis for Planning (IMPLAN) national input-output model that specifically estimates the employment and income effects of building energy technologies. IMPLAN was developed originally by the U.S. Forest Service in cooperation with the Federal Emergency Management Agency (FEMA) and the Bureau of Land Management (BLM) to assist the Forest Service in land and resource management planning. IMBUILD is an economic analysis system that focuses on those sectors most relevant to buildings, and characterizes the interconnections among 35 sectors as national input-output matrices. The IMBUILD output includes employment, industry output, and wage income. Changes in expenditures due to appliance standards can be introduced to IMBUILD as perturbations to existing economic flows, and the resulting net national impact on jobs by sector can be estimated.

2.12 ENVIRONMENTAL ASSESSMENT

The Department intends to conduct an assessment of the impacts of proposed furnace and boiler standards levels on certain environmental indicators, using NEMS-BT to provide key inputs to the assessment and generate the impacts. When necessary, some exogenous calculations will be performed. Results of the environmental assessment are similar to those provided in *AEO2003*. The Department will conduct the environmental assessment work during the NOPR stage of this rulemaking.

The Environmental Assessment considers two pollutants, sulfur dioxide (SO_2) and nitrogen oxides (NO_x), and one emission, carbon (tracked in the NEMS-BT as carbon dioxide (CO_2)). For each of the energy-efficiency standards levels, the Department will calculate total emissions using NEMS-BT and external analyses as needed.

The Department intends to conduct the environmental assessment as a policy deviation from the *AEO2003*, applying the same basic set of assumptions. For example, the emissions characteristics of an electricity generating plant will be exactly those used in *AEO2003*. The Department's assessment will take into account any factors affecting the type of electricity generation and, in turn, the type and amount of airborne emissions being generated by the utility industry.

The results of the environmental assessment will be similar to a complete NEMS run as published in the *AEO2003*. These include power sector emissions for SO_2, NO_x, and carbon, and SO_2 prices, in five-year forecasted increments extrapolated to the year 2030. The Department will report the outcome of the assessment for each trial standard level as a deviation from the *AEO2003* reference cases.

2.13 REGULATORY IMPACT ANALYSIS

The Department intends to prepare a draft regulatory impact analysis pursuant to E.O. 12866, "Regulatory Planning and Review," which would be subject to review under the Executive Order by the Office of Information and Regulatory Affairs (OIRA) 58 FR 51735 (October 4, 1993). The Department will conduct the regulatory impact analysis during the NOPR stage of this rulemaking.

As part of the regulatory impact analysis, the Department will identify and seek to mitigate the overlapping effects on manufacturers of new or revised DOE energy efficiency standards and other regulatory actions affecting the same equipment. Through manufacturer interviews and literature searches, the Department will compile information on burdens from existing and impending regulations affecting residential furnaces and boilers.

The Department's NOPR will include a complete quantitative analysis of alternatives to the proposed energy conservation standards. The Department plans to use the NES Spreadsheet Model (as discussed earlier in the section on the national impact analysis) to calculate the NES and the NPV corresponding to specified alternatives to the proposed conservation standards.

REFERENCES

1. U.S. Department of Energy-Office of Energy Efficiency and Renewable Energy, Procedures, Interpretations, and Policies for Consideration of New or Revised Energy Conservation Standards for Consumer Products; Final Rule. *Federal Register*, 1996. 61(136): pp. 36974-36987.

2. U.S. Department of Energy - Energy Information Administration, *Residential Energy Consumption Survey: Household Energy Consumption and Expenditures 1997*, 1999. Washington, DC. Report No. DOE/EIA-0321(97). <http://www.eia.doe.gov/emeu/recs/recs97/publicusefiles.html>